PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-201694

(43)Date of publication of application : 09.08.1996

---

(51)Int.Cl. G02B 15/16
G02B 27/64

---

(21)Application number : 07-031881 (71)Applicant : SONY CORP

(22)Date of filing : 30.01.1995 (72)Inventor : KIKUCHI SHUICHI
TANAKA KAZUHIRO
ISHIHARA KIICHI

---

(54) IMAGE BLURRING CORRECTING VARIABLE POWER OPTICAL SYSTEM

(57)Abstract:
PURPOSE: To decrease the effective diameter of a fixed lens by making a front lens composing an afocal front group a movable lens and a lens arranged behind the fixed lens in an image blurring correcting variable power optical system.
CONSTITUTION: A first group A1 and a succeeding variable power group A2 are arranged in order from the object side in an optical system A and the first group A1 is composed of a front group A1F of an afocal system and a rear group A1R having a positive refractive power. The front group A1F is composed of a movable group A1Fa and a fixed group A1Fb arranged behind and when the optical system A is inclined, the movable group A1Fa is moved in the direction orthogonal to the optical axis L-L by means of a lens driving part LD. By making the movable group A1Fa a positive lens and the fixed group A1Fb a negative lens, the interval between the fixed group A1Fb and

the rear group A1R is shortened. By making the movable group A1Fa a negative lens and the fixed group A1Fb a positive lens, the focal distance of the system is shortened and the viewing angle is expanded.

---

LEGAL STATUS [Date of request for examination] 19.01.2001
[Date of sending the examiner's decision of rejection] 04.12.2002
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]



---

## CLAIMS

---

[Claim(s)]
[Claim 1] While the 1st group is constituted by the pre-group of an afocal system, and the rear group with forward refractive power in the image Bure amendment variable power optical system which comes to arrange the 1st group made into migration impossible in the direction of an optical axis, and the variable power group following this 1st group sequentially from [ this ] a body side Image Bure amendment variable power optical system characterized by being moved in the direction in which a movable group intersects perpendicularly to an optical axis with a lens migration means when a pre-group consists of a movable group and a fixed group arranged in

the back and variable power optical system inclines.

[Claim 2] Image Bure amendment variable power optical system to which a movable group is characterized by using a positive lens and a fixed group as a negative lens in image Bure amendment variable power optical system according to claim 1.

[Claim 3] Image Bure amendment variable power optical system to which a movable group is characterized by using a negative lens and a fixed group as a positive lens in image Bure amendment variable power optical system according to claim 1.

---

## DETAILED DESCRIPTION

---

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention is the image Bure amendment variable power optical system which was made to perform image Bure amendment by moving the movable group which constitutes an afocal system in the direction which intersects perpendicularly to the optical axis of the whole system. By making a near lens group into a movable group, before constituting an afocal system, and making into a fixed group the lens group arranged behind that It is going to offer the new image Bure amendment variable power optical system which enabled it to make small the effective diameter of the lens concerning a fixed group, and enables it to perform suitable image Bure amendment in the optical system of the video camera of a pocket mold etc.

[0002]

[Description of the Prior Art] When the small video camera of a pocket mold etc. reproduces the image which a hand deflection tended to produce in eye lightweight backlash at the time of photography, for example, was photoed by zoom-in, image Bure will produce it.

[0003] Then, while various kinds of methods are proposed about hand deflection amendment, for example, a hand deflection sensor detects a motion of the body of equipment, the lens system which is made to move the lens group which constitutes a part of photography system, and lost image Bure is known.

[0004] for example, the optical system a shown in drawing 8 consists of five lens groups arranged along with optical-axis L-L, and constitutes the 1st group G1 -- a body side is the most afocal -- it considers as the configuration by which the positive lens with section A1F [ movable behind a negative lens ] has been arranged. And rear group A1R which constitutes the 1st group G1 is constituted by three lenses, one sheet and the 4th group G4 are constituted by two lenses, and the 5th group G5 is constituted [ the 2nd group G2 ] for three sheets and 3rd group G3 by the filter of

three sheets, respectively.

[0005] In addition, in front of the lens of 3rd group G3, the diaphragm (it is described as "STOP" by a diagram.) is arranged, and let the image surface (it is described as "SF" by a diagram) be the location which only a predetermined distance isolated behind the 5th group G5.

[0006] afocal in this example -- it has the composition which moves to the direction which uses a biconcave lens and a biconvex lens for two lenses which constitute section A1F, uses as a fixed lens the biconcave lens b1 located in a before side, uses as a moving lens the biconvex lens b2 located in the backside, and carries out a perpendicular to optical-axis L-L with a migration means to by_which a biconvex lens b2 is not illustrated, i.e., the upper and lower sides, and a longitudinal direction.

[0007] The beam of light c shows the optical path when performing image Bure amendment so that optical-axis L-L may be met by moving a biconvex lens b2 in the direction shown in an arrow head D to the light which carries out incidence to lens system a with an include angle theta to optical-axis L-L.

[0008]

[Problem(s) to be Solved by the Invention] by the way, afocal as mentioned above -- if it is in the optical system which uses the backside [ section A1F ] lens b2 as a moving lens, the magnitude of a moving lens has determined the outer diameter of the whole system, and since it is difficult to make the effective diameter of a moving lens small, there is a problem of being the cause by which this obstructs the miniaturization of equipment.

[0009] in addition, afocal -- the effective diameter of the lens of the 2nd (backside) lens b2 in section A1F is called for by ray-tracing processing in consideration of the beam-of-light location in image quantity and a diaphragm side etc.

[0010] That is, in order to receive light, without the quantity of light in the image surface running short, the conditions that a beam of light arrives at the effective area of an electric eye must be satisfied. For example, in a 1/4 inch CCD mold area image sensor, h= 2.25mm of image quantities is needed.

[0011] Moreover, even when a diaphragm is narrowed down to the limit, in order for a beam of light to arrive at the image surface, a beam of light needs to extract and it is necessary to pass along the core of a field.

[0012] The beam of light d shown in drawing 8 is obtained by performing ray tracing to a before side (body side) so that the above conditions may be fulfilled, and it is calculated by applying a Snell's law to each lens side using the software for optical designs. Consequently, the intersection A of a beam of light d and the field by the side of the body of a lens b2 (referred to as "S3".) is decided, and an effective diameter is prescribed by height h of the intersection A obtained when moving a lens b2 in the direction which intersects perpendicularly to optical-axis L-L (what doubled the sum of height h and the movement magnitude of a lens b2 two serves as an effective

diameter.).

[0013] drawing 9 is afocal -- back [ in section A1F ], it is a schematic diagram for explaining the effective diameter of this moving lens at the time of using the near lens b2 as a moving lens.

[0014] Drawing 9 (a) shows the beams of light f1 and f2 in case the center of the lens b2 arranged in front of the taking-lens system e is exactly located on an optical axis, and drawing 9 (b) shows the beams of light g1 and g2 at the time of moving in the direction which intersects perpendicularly to optical-axis L-L as a lens b2 shows an arrow head B. In order that the direction of a beam of light g2 may pass through the location of the periphery approach of a lens b2 compared with a beam of light f2 so that clearly from both comparison, there is an inclination for an effective diameter to become large. That is, an effective diameter must be enlarged so that light may not separate from the periphery section of a lens b2, as the amount of amendments (that is, movement magnitude of a lens b2) becomes large, when image Bure amendment is being performed by moving the lens b2 on the backside.

[0015]

[Means for Solving the Problem] Then, in order to solve the above-mentioned technical problem, the 1st group made into migration impossible in the direction of an optical axis and the variable power group following this 1st group set this invention to the image Bure amendment variable power optical system which comes to be arranged sequentially from [ this ] a body side. While the 1st group is constituted by the pre-group of an afocal system, and the rear group with forward refractive power A pre-group consists of a movable group and a fixed group arranged in the back, and when variable power optical system inclines, it is made to be moved in the direction in which a movable group intersects perpendicularly to an optical axis with a lens migration means.

[0016]

[Function] Since according to this invention it is hard coming to separate light from the lens periphery section of a fixed group even if the movement magnitude of a movable group becomes large by making a before side lens group into a movable group in an afocal system pre-group, and arranging a fixed group to the back, the effective diameter of the lens concerning a fixed group can be made small.

[0017]

[Example] Below, it explains according to each example illustrating this invention image Bure amendment variable power optical system. The shaft which drawing 1 shows the basic configuration of this invention image Bure amendment variable power optical system, and is shown by "L-L" all over drawing shows the optical axis of the whole system.

[0018] Optical system A has the configuration of the variable power optical system by which the 1st group A1 and the variable power group A2 have been arranged

sequentially from a body side.

[0019] it came to arrange rear group A1R to which the 1st group A1 has pre-group A1F (henceforth the "afocal section") of an afocal system, and forward refractive power in order from a body side, and pre-group A1F were located in the object side -- movable -- it consists of group A1Fa and fixed group A1Fb located in the back.

[0020] movable -- group A1Fa is moved in the direction which intersects perpendicularly to optical-axis L-L with the lens migration means LD, and the position control is performed. in addition, although illustration is omitted, it detects the inclination of optical system A and is movable -- after a sensor's detecting pitching and rolling of optical system A and processing the output signal by control sections, such as a microcomputer, as a control system which performs migration control of group A1Fa, for example, the configuration which amends image Bure can be mentioned by sending out a control signal to the lens migration means LD.

[0021] drawing 2 is the schematic diagram showing the example of a configuration of optical system A, and its 1st group is afocal -- only section A1F are shown.

[0022] afocal -- section A1F are constituted by the movable group LS 1 with negative refractive power, and the fixed group LS 2 with forward refractive power.

[0023] drawing 4 is a schematic diagram for explaining a near lens group as contrasted with drawing 9 about the effective diameter of the fixed group LS 2 at the time of considering as the movable group LS 1, front [ in the afocal section ], and lens system e in drawing is afocal -- the taking-lens system except section A1F is shown.

[0024] Drawing 4 (a) shows the beams of light f1 and f2 in case the center of the movable group LS 1 is exactly located on optical-axis L-L, and drawing 4 (b) shows the beam of light i1 at the time of moving in the direction which intersects perpendicularly to optical-axis L-L as the movable group LS 1 shows an arrow head B, and i2. Since a beam of light i1 and i2 pass along the neighborhood of beams of light f1 and f2 so that clearly from both comparison, compared with the case of drawing 9 , the effective diameter of the fixed group LS 2 becomes small. That is, in performing image Bure amendment by moving the movable group LS 1 by the side of before, even if the amount of amendments (that is, movement magnitude of the movable group LS 1) becomes large, there is an inclination to be hard coming to separate light from the periphery section of the fixed group LS 2.

[0025] Since both the above-mentioned movable group LS 1 and the fixed group LS 2 constitute the afocal system, they can reverse the relation of both about refractive power.

[0026] That is, as shown in drawing 3 , you may make it the configuration which has arranged the movable group LT 1 with forward refractive power to the before side, and has arranged the fixed group LT 2 which has negative refractive power behind that.

[0027] Next, the examples 1 and 2 concerning this invention are explained.

[0028] in addition, movable in the example 1 -- group A1Fa is used as a negative lens,

and fixed group A1Fb is used as a positive lens, and movable in another side and the example 2 -- group A1Fa is used as a positive lens, and let fixed group A1Fb be a negative lens.

[0029] The definition of the notation used below is collectively shown in the following table 1.

[0030]

[Table 1]

| 記号 | 意味 |
|---|---|
| r | 面の曲率半径 |
| d | 面間隔 |
| N | d線の屈曲率 |
| ν | アッベ数 |
| f | 全系の焦点距離 |
| FNO | 全系のFナンバー |
| ω | 半画角 |

[0031] In addition, the value at the time of normalizing to f= 1 in the numerical table mentioned later about ******** among [ f, r, and d ] the amounts of many of Table 1 is shown.

[0032] drawing 5 shows an example 1, optical-system 1A consists of five lens groups, and the 1st group G1 is constituted -- a body side is the most afocal -- the positive lens of immobilization behind a negative lens with movable section A1F has been arranged -- it is constituted. And rear group A1R which constitutes the 1st group G1 is constituted by three lenses, one lens and the 4th group G4 are constituted by two lenses, and the 5th group G5 is constituted [ the 2nd group G2 ] for three lenses and 3rd group G3 by the filter of three sheets, respectively.

[0033] In giving a field number (this being set to "i".) to each side of a lens It shall increase every [ 1 ] as it goes to an image surface side from a body side. Also about the radius of curvature ri (i= 1, 3 [ 2 and 3 ], ...) and the lens spacing di (i= 1, 3 [ 2 and 3 ], ...) of each field It is the following table which defined it as what increases every

[ 1 ] as the suffix i went to the image surface side from the body side, and showed the configuration of optical-system 1A in the numerical table.
[0034]
[Table 2]

| 面番号 | r | d | N | ν |
|---|---|---|---|---|
| 1 | -19.5857 | 0.4461 | 1.49200 | 58.00 |
| 2 | 14.0448 | 0.3310 | | |
| 3 | 14.9903 | 1.3949 | 1.49200 | 58.00 |
| 4 | -19.4059 | 0.2231 | | |
| 5 | 10.4735 | 0.2454 | 1.84666 | 23.78 |
| 6 | 6.0939 | 0.8654 | 1.62041 | 60.34 |
| 7 | -141.1298 | 0.0446 | | |
| 8 | 5.2981 | 0.5524 | 1.62041 | 60.34 |
| 9 | 11.2874 | variable | | |
| 10 | 8.4710 | 0.1561 | 1.83400 | 37.35 |
| 11 | 1.3982 | 0.9536 | | |
| 12 | -4.6665 | 0.1976 | 1.60342 | 38.01 |
| 13 | 1.8223 | 0.4623 | 1.92286 | 20.88 |
| 14 | 8.3807 | variable | | |
| 15 | INFINITY(stop) | 0.1561 | | |
| 16 | 4.0685 | 0.4709 | 1.58913 | 61.25 |
| 17 | -15.7475 | variable | | |
| 18 | 2.7786 | 0.1561 | 1.84666 | 23.78 |
| 19 | 1.4967 | 1.0350 | 1.58913 | 61.25 |
| 20 | -5.3164 | variable | | |
| 21 | INFINITY | 0.3569 | 1.51680 | 64.20 |
| 22 | INFINITY | 0.4573 | 1.55232 | 63.42 |
| 23 | INFINITY | 0.1785 | | |
| 24 | INFINITY | 0.1673 | 1.55671 | 58.56 |
| 25 | INFINITY | | | |

[0035] In addition, it is referred to as f=1-14, FNO=1:1.65-2.64, and 2 and

omega=55.7−4.1 in this example.

[0036] In "INFINITY", "STOP" which shows that radius of curvature is infinity, i.e., a flat side, and is shown in r15 means the diaphragm among Table 2. Moreover, the refractive index about air is omitted with the blank in a refractive index N.

[0037] And it is shown that "variable" is a moving lens which a lens moves in the direction of an optical axis. By this example, the lens spacing d9, d14, d17, and d20 is variable length, and relation with a focal distance f is shown in the following table.

[0038]

[Table 3]

| d \ f | 1.0000 | 2.6110 | 13.9543 |
|---|---|---|---|
| d 9 | 0.3792 | 3.1512 | 5.9233 |
| d 1 4 | 5.8675 | 3.0955 | 0.3234 |
| d 1 7 | 2.1235 | 1.5684 | 2.5161 |
| d 2 0 | 1.4566 | 2.0130 | 1.0650 |

[0039] In addition, the field number i= 2 and the lens side of 4, 17, and 20 are made into the aspheric surface configuration expressed with a bottom type, and if they show those aspheric surface multipliers by the tabular format, they will become as it is shown in the following table. In addition, the coordinate of the direction of an optical axis of the aspheric surface is set to "Xa", and distance from an optical axis is set to "y."

[0040]

[Equation 1]

$$|Xa| - |Xs| < 0$$

ここで、

$$Xa = \frac{c \cdot y^2}{1 + \sqrt{1 - c^2 \cdot y^2}} + \sum_{i=1}^{N} A_{2i} \cdot y^{2i}$$

$$Xs = \frac{c \cdot y^2}{1 + \sqrt{1 - c^2 \cdot y^2}}$$

$c$は近軸曲率、$A_{2i}$は2$i$（偶数）次の非球面係数である。

[0041]

[Table 4]

| 面番号 | $A_4$ | $A_6$ | $A_8$ |
|---|---|---|---|
| 2 | -1.03489e-04 | -2.07376e-06 | 5.61341e-08 |
| 4 | 9.19560e-05 | 1.31157e-06 | -1.45478e-08 |
| 1 7 | 4.68492e-03 | 8.58483e-04 | -2.79114e-04 |
| 2 0 | 4.17919e-03 | -4.44989e-03 | 1.55411e-03 |

[0042] The degree of an aspheric surface multiplier is set to 4, 6, and 8 in this example. Moreover, "e" of front Naka means the exponential notation which uses 10 as a bottom.

[0043] The beam of light c1 in drawing 5 shows the optical path when performing image Bure amendment so that optical-axis L-L may be met by moving the 2nd lens in the direction of an arrow head B to the light which carries out incidence to lens

system 1A with an include angle theta to optical-axis L-L.

[0044] Moreover, like the beam of light d shown in drawing 8 , a beam of light d1 is obtained by performing ray tracing so that the conditions about the passage location in an effective light-receiving side or a diaphragm side may be fulfilled, and the twice of the height h1 of the intersection A1 of a beam of light d1 and the field by the side of the body of the 2nd lens (field number i= 3) are an effective diameter.

[0045] drawing 6 shows an example 2, optical-system 1B consists of five lens groups, and the 1st group G1 is constituted -- a body side is the most afocal -- the negative lens of immobilization behind a positive lens with movable section A1F has been arranged -- it is constituted. And rear group A1R which constitutes the 1st group G1 is constituted by three lenses, one lens and the 4th group G4 are constituted by two lenses, and the 5th group G5 is constituted [ the 2nd group G2 ] for three lenses and 3rd group G3 by the filter of three sheets, respectively.

[0046] It is the following table which defined the field number of a lens, the radius of curvature of each side, and lens spacing, and showed the configuration of optical-system 1B like the case of the above mentioned example 1 in the numerical table.

[0047]

[Table 5]

| 面番号 | r | d | N | ν |
|---|---|---|---|---|
| 1 | 19.4059 | 1.3949 | 1.49200 | 58.00 |
| 2 | -14.9903 | 0.3310 | | |
| 3 | -14.0448 | 0.4461 | 1.49200 | 58.00 |
| 4 | 19.5857 | 0.2231 | | |
| 5 | 10.4735 | 0.2454 | 1.84666 | 23.78 |
| 6 | 6.0939 | 0.8654 | 1.62041 | 60.34 |
| 7 | -141.1298 | 0.0446 | | |
| 8 | 5.2981 | 0.5524 | 1.62041 | 60.34 |
| 9 | 11.2874 | variable | | |
| 10 | 8.4710 | 0.1561 | 1.83400 | 37.35 |
| 11 | 1.3982 | 0.9536 | | |
| 12 | -4.6665 | 0.1976 | 1.60342 | 38.01 |
| 13 | 1.8223 | 0.4623 | 1.92286 | 20.88 |
| 14 | 8.3807 | variable | | |
| 15 | INFINITY(stop) | 0.1561 | | |
| 16 | 4.0685 | 0.4709 | 1.58913 | 61.25 |
| 17 | -15.7475 | variable | | |
| 18 | 2.7786 | 0.1561 | 1.84666 | 23.78 |
| 19 | 1.4967 | 1.0350 | 1.58913 | 61.25 |
| 20 | -5.3164 | variable | | |
| 21 | INFINITY | 0.3569 | 1.51680 | 64.20 |
| 22 | INFINITY | 0.4573 | 1.55232 | 63.42 |
| 23 | INFINITY | 0.1785 | | |
| 24 | INFINITY | 0.1678 | 1.55671 | 58.56 |
| 25 | INFINITY | | | |

[0048] In addition, in this example, it is f=1.1-15.5, FNO=1:1.65-2.64, and 2 and omega=51-3.7. Moreover, it is as having mentioned above about semantics, such as "INFINITY" in Table 5, and "variable."

[0049] Moreover, in an example 2, the lens spacing d9, d14, d17, and d20 is variable length, and those of the relation between these and a focal distance f is the same as that of said table 3. Moreover, the field number i= 2 and the lens side of 4, 17, and 20 are made into the aspheric surface configuration, and those aspheric surface

multipliers are as having been shown in said table 4.

[0050] The beam of light c2 in drawing 6 shows the optical path when performing image Bure amendment so that optical-axis L-L may be met by moving the 2nd lens in the direction of an arrow head D to the light which carries out incidence to optical-system 1B with an include angle theta to optical-axis L-L.

[0051] Moreover, like the beam of light d shown in drawing 8 , a beam of light d2 is obtained by performing ray tracing so that the conditions about the passage location in an effective light-receiving side or a diaphragm side may be fulfilled, and the twice of the height h2 of the intersection A2 of a beam of light d2 and the field by the side of the body of the 2nd lens (field number i= 3) are an effective diameter.

[0052] The following table about the optical system 1A and 1B concerning this invention, and the aforementioned optical system a (the configuration side supposes that it is the same as the numerical table 3.) in the case of theta= 1.16 degrees of amendment angles Movement magnitude m of the moving lens (optical system 1A and 1B the 1st lens and optical system a the 2nd lens) when normalizing f to 1 (the upper part is made into the forward direction and a lower part is made into the negative direction.) The lens effective diameter phi of the 2nd (backside) sheet is compared and shown.

[0053]

[Table 6]

| | 移動量m | 有効径φ |
|---|---|---|
| 光学系a | -0.335 | 6.17 |
| 光学系1A | +0.335 | 5.50 |
| 光学系1B | -0.351 | 5.32 |

[0054] It turns out that the lens effective diameter phi of the 2nd (backside) sheet in optical system 1A and 1B is small compared with the lens effective diameter of optical system a.

[0055] In addition, it is more advantageous about the overall length of optical system to use the moving lens of the afocal section as a biconvex lens in the comparison with optical system 1A and 1B. This is because the rear group of the afocal section is a

positive lens, an object side face is convex, so the direction which used as the biconcave lens the fixed lens located ahead [ the ] can make lens spacing small.

[0056] On the contrary, it is more advantageous to use the moving lens of the afocal section as a biconcave lens about a field angle. This is because a focal distance becomes long, when a moving lens is a biconvex lens.

[0057] Drawing 7 (a) is what indicates the focus F1 and the principal point H1, and a focal distance f1 to be taking-lens e. Drawing 7 (b) shows the focus F2 when the biconvex lens and the biconcave lens have been arranged in this order from the front like the case of optical-system 1B ahead of taking-lens e and the principal point H2, and a focal distance f2. Moreover, drawing 7 (c) shows the focus F3 when the biconcave lens and the biconvex lens have been arranged in this order from the front like the case of optical-system 1A ahead of a taking lens and the principal point H3, and a focal distance f3.

[0058] Like drawing 7 (b), if a biconvex lens is arranged to a before side, a focal distance will become long, a field angle will become small, but like drawing 7 (c), if a biconcave lens is arranged to a before side, a focal distance becomes short and a large field angle can be taken.

[0059]

[Effect of the Invention] Since it is hard coming to separate light from the lens periphery section of a fixed group according to invention concerning claim 1 by making a before side lens group into a movable group in an afocal system pre-group, and arranging a fixed group to the back even when the movement magnitude of a movable group is large so that clearly from the place indicated above, the effective diameter of the lens concerning a fixed group can be made small.

[0060] Moreover, according to invention concerning claim 2, lens spacing of a fixed group and a rear group with forward refractive power becomes short by using a movable group as a positive lens and using a fixed group as a negative lens, and the overall length of optical system can be shortened by this.

[0061] According to claim 3, by using a movable group as a negative lens and using a fixed group as a positive lens, the focal distance of a system can be shortened and a big field angle can be obtained.

---

## DESCRIPTION OF DRAWINGS

---

[Brief Description of the Drawings]

[Drawing 1] It is the schematic diagram showing the basic configuration of the image Bure amendment variable power optical system concerning this invention.

[Drawing 2] It is drawing showing the example which used the movable group of the

afocal section as the negative lens, and used the fixed group as the positive lens in the image Bure amendment variable power optical system concerning this invention.
[Drawing 3] It is drawing showing the example which used the movable group of the afocal section as the positive lens, and used the fixed group as the negative lens in the image Bure amendment variable power optical system concerning this invention.
[Drawing 4] It is a schematic diagram for explaining the effective diameter of a moving lens in the optical system of drawing 2 , and (a) shows the condition that the center of the movable group LS 1 is exactly located on optical-axis L-L, and (b) shows the condition of having moved in the direction in which moving lens LS1 intersects perpendicularly to optical-axis L-L.
[Drawing 5] It is drawing showing the configuration of example 1A concerning this invention.
[Drawing 6] It is drawing showing the configuration of example 1B concerning this invention.
[Drawing 7] It is a schematic diagram for explaining the advantage which uses the moving lens of an afocal system pre-group as a biconcave lens.
[Drawing 8] It is drawing showing the conventional example of a configuration.
[Drawing 9] It is drawing for explaining the conventional trouble.
[Description of Notations]
A Image Bure amendment variable power optical system
A1 The 1st group
A1F Afocal section (pre-group)
A1Fa Movable group
A1Fb Fixed group
A1R Rear group
LD Lens migration means
1A, 1B Image Bure amendment variable power optical system